

WHAT IS CLAIMED IS:

1. An illumination maintenance system for maintaining a desired illumination profile in a space throughout at least a portion of a day where the illumination sources include daylight and artificial light, the system comprising:
  - a sensor for sensing an illumination level in at least a portion of the space;
  - 5 a plurality of electric lamps providing artificial light to supplement the daylight illumination of the space; the electric lamps being dimmable and being arranged in one or more zones in the space, the zones defining predefined volumes of the space, each zone having at least one lamp;
  - a control system controlling the dimming levels of the plurality of electric lamps to maintain the desired illumination profile in the space, the at least one lamp of each zone being controlled to a dimming level to achieve a desired illumination level in the respective zone according to the desired illumination profile;
  - 10 the control system controlling the plurality of electric lamps so that the dimming level of each lamp is adjusted to achieve the desired illumination profile and compensate for the daylight illumination in the space throughout at least the portion of the day;
  - 15 wherein the dimming level of each lamp is selected by the control system from one of a plurality of lighting presets, each preset comprising a combination of dimming levels of the lamps and wherein the control system fades the electric lamps toward a preset that will result in an appropriate supplementing of the daylight illumination to achieve the desired illumination profile in the space; and
  - 20 the control system operating such that, when the desired illumination profile is achieved within a predefined tolerance, the control system stops varying the dimming levels of the lamps.

2. The system of claim 1, wherein control of the electric lamps is based on an open loop control algorithm or a closed loop control algorithm.

3. The system of claim 1, further comprising a plurality of first sensors for sensing the illumination level in the space.

4. The system of claim 3 wherein a combined output level of the first sensor is determined by averaging outputs of the plurality of first sensors.

5. The system of claim 1, wherein the control system includes an astronomical time clock, and wherein time of day data provided by the time clock is used to correct for a spectral sensitivity property of the sensor.

6. The system of claim 1, further comprising at least one electrically controllable window treatment for at least one opening into the space and wherein the control system controls the window treatment to allow daylight into the space.

7. The system of claim 6, wherein the control system adjusts the window treatment to increase the amount of daylight entering the space when the illumination level detected by said first sensor is too low.

8. The system of claim 6, wherein the control system adjusts the window treatment to decrease the amount of daylight entering the space when the illumination level detected by said first sensor is too high.

9. The system of claim 1, wherein the control system compares the

illumination level in the space to first and second thresholds, the first threshold corresponding to a light level that is too dark and the second threshold corresponding to a light level that is too high.

10. The system of claim 9, wherein the control system adjust the sensitivity of the first sensor to compensate for the first sensor's differing sensitivity to different light sources.

11. The system of claim 9, further wherein the control system has a main control loop in which the illumination level is compared to the first and second thresholds and a first subloop to select an appropriate dimming level of the plurality of electric lamps when the light level is too dark and a second subloop to select an appropriate dimming level of the plurality of electric lamps when the light level is too high.

5 12. The system of claim 11, wherein the control system determines in the main central loop if the light level is acceptable.

13. The system of claim 11, wherein the dimming levels comprise a plurality of preset dimming levels.

14. An illumination maintenance system for maintaining a desired illumination profile in a space throughout a least a portion of a day where the illumination source comprises daylight entering the space, the system comprising:  
a first sensor for sensing an illumination level in at least a portion of the  
5 space;

at least one electrically controllable window treatment for at least one opening for allowing daylight into the space, the window treatment selectively altering the amount of daylight entering the space through the opening;

10           a control system controlling the at least one window treatment;

          the control system controlling the at least one window treatment to achieve the desired illumination profile in the space throughout at least the portion of the day;

          and

          wherein the control system stops adjusting the at least one window treatment when the desired illumination profile within a predefined tolerance has been

15           achieved.

15.        The system of claim 14, further comprising a plurality of first sensors for sensing the illumination level in the space.

16.        The system of claim 14, wherein the illumination source further comprises electric lamps illuminating the space.

17.        The system of claim 14, wherein the control system includes an astronomical time clock, and wherein time of day data provided by the time clock is used to correct for a spectral sensitivity property of the sensor.

18.        The system of claim 14, wherein the control system adjusts the window treatment to increase the amount of daylight entering the space when the illumination level detected by said first sensor is too low.

19.        The system of claim 14, wherein the control system adjusts the

window treatment to decrease the amount of daylight entering the space when the illumination level detected by said first sensor is too high.

20. The system of claim 14, wherein the control system compares the illumination level in the space to first and second thresholds, the first threshold corresponding to a light level that is too dark and the second threshold corresponding to a light level that is too high.

21. A system for reducing sun glare through an opening into a space, the system comprising:

at least one electrically controllable window treatment for at least one opening for allowing daylight into the space, the window treatment selectively altering the amount of daylight entering the space through the opening;

5 a sensor for sensing daylight illumination entering the space;

a control system controlling the at least one window treatment; and

the control system operating to adjust the window treatment in the event of sun glare through the opening to reduce the sun glare, and such that when the sun 10 glare has been minimized, the control system stops the adjustment of the at least one window treatment.

22. The system of claim 21, wherein the control system employs a dead-band having upper and lower set points such that if the sensed illumination in the space is outside the dead-band, the window treatment is adjusted to bring the illumination level in the space within the dead-band.

23. The system of claim 22, wherein the control system employs a time

delay before moving the window treatment to bring the illumination level in the space back within the dead-band.

24. The system of claim 23, wherein the time delay to bring the illumination level in the space back within the dead-band is shorter for high illumination levels than for low illumination levels.

25. The system of claim 24, wherein the time delay is reduced if daylight illumination is consistently high or consistently low.

26. The system of claim 22, wherein, during a time period when glare from the sun through the opening can occur, at least one set point of the dead-band can be varied to reduce glare.

27. The system of claim 26, wherein a set point is variable during a time period determined by an estimated angle of the sun.

28. The system of claim 27, wherein the set point is reduced during the time period when glare from the sun through the opening can occur.

29. The system of claim 27, wherein the set point is variable during periods approximately three hours after sunrise and three hours before sunset.

30. The system of claim 27, wherein the control system includes an astronomical time clock and the set point is calculated in response to the time determined by the time clock.

31. The system of claim 21, wherein the sensor has a gain factor, and the control system adjusts the gain factor during the time period when glare from the sun through the opening can occur.

32. The system of claim 31, wherein the gain factor is increased during the time period when glare from the sun through the opening can occur.

33. The system of claim 22, wherein a user can manually adjust the window treatment, and further wherein at least one of the set points is temporarily adjusted after a manual adjustment to match the light level measured after the manual adjustment.

34. The system of claim 33, wherein the control system reverts to a default set point after the light level exceeds a predefined dead-band around the temporary set point set after a manual adjustment.

35. The system of claim 34, wherein the default set point is adjusted automatically after the control system detects a repeated manual adjustment of the window treatment.

36. The system of claim 21, wherein the control system includes an astronomical time clock, and wherein the time of day data provided by the time clock is used to correct for a spectral sensitivity property of the sensor.

37. An illumination maintenance system for maintaining a desired illumination profile in a space throughout at least a portion of a day where the

illumination source comprises daylight entering the space, the system comprising:

- 5            at least one electrically controllable window treatment for at least one opening for allowing daylight into the space, the window treatment selectively altering the amount of daylight entering the space through the opening;
- 10            a sensor for sensing daylight illumination entering the space;
- a control system controlling the at least one window treatment, to maintain the desired illumination profile in the space throughout at least the portion of the day; and

              the control system further operating to adjust the window treatment in the event of sun glare through the opening to reduce the sun glare, and such that when the desired illumination profile within a predefined tolerance is achieved, the control system stops the adjustment of the at least one window treatment.

38.        The system of claim 37, wherein the illumination source further comprises electric lamps illuminating the space.

39.        The system of claim 37, wherein the control system employs a dead-band having upper and lower set points such that if the sensed illumination in the space is outside the dead-band, the window treatment is adjusted to bring the illumination level in the space within the dead-band.

40.        The system of claim 39, wherein the control system employs a time delay before moving the window treatment to bring the illumination level in the space back within the dead-band.

41.        The system of claim 40, wherein the time delay to bring the

illumination level in the space back within the dead-band is shorter for high illumination levels than for low illumination levels.

42. The system of claim 41, wherein the timing delay is reduced if daylight illumination is consistently high or consistently low.

43. The system of claim 40, wherein during a time period when glare from the sun through the opening can occur, at least one set point of the dead-band can be varied to reduce glare.

44. The system of claim 43, wherein a set point is variable during a time period determined by an estimated angle of the sun.

45. The system of claim 44, wherein the set point is reduced during the time period when glare from the sun through the opening can occur.

46. The system of claim 44, wherein the set point is variable during periods approximately three hours after sunrise and three hours before sunset.

47. The system of claim 44, wherein the control system includes an astronomical time clock and the set point is calculated in response to the time determined by the time clock.

48. The system of claim 37, wherein the sensor has a gain factor, and the control system adjusts the gain factor during the time period when glare from the sun through the opening can occur.

49. The system of claim 48, wherein the gain factor is increased during the time period when glare from the sun through the opening can occur.

50. The system of claim 39, wherein a user can manually adjust the window treatment, and further wherein at least one of the set points is temporarily adjusted after a manual adjustment to match the light level measured after the manual adjustment.

51. The system of claim 50, wherein the control system reverts to a default set point after the light level exceeds a predefined dead-band around the temporary set point set after a manual adjustment.

52. The system of claim 51, wherein the default set point is adjusted automatically after the control system detects a repeated manual adjustment of the window treatment.

53. The system of claim 37, wherein the control system includes an astronomical time clock, and wherein the time of day data provided by the time clock is used to correct for a spectral sensitivity property of the sensor.

54. The system of claim 37, wherein the control system adjusts the window treatment to maximize the amount of daylight entering the space when the illumination level detected by said first sensor is too low.

55. The system of claim 37, wherein the control system adjusts the window treatment to minimize the amount of daylight entering the space when the

illumination level detected by said first sensor is too high.

56. The system of claim 37, wherein the control system compares the illumination level in the space to first and second thresholds, the first threshold corresponding to a light level that is too dark and the second threshold corresponding to a light level that is too high.

57. An illumination maintenance system for maintaining a desired illumination profile in a space throughout at least a portion of a day where the illumination sources include daylight and artificial light, the system comprising:

5 a first sensor for sensing an illumination level in at least a portion of the space;

at least one electrically controllable window treatment for at least one opening for allowing daylight into the space, the window treatment selectively altering the amount of daylight entering the space through the opening;

10 a plurality of electric lamps providing artificial light to supplement the daylight illumination of the space, the electric lamps being dimmable;

a control system controlling the at least one window treatment and the plurality of electric lamps to maintain the desired illumination profile in the space;

15 the control system controlling the plurality of electric lamps so that the dimming level of each lamp is adjusted to achieve the desired illumination profile and compensate for the daylight illumination in the space throughout at least the portion of the day; and

the control system further operating to adjust the at least one window treatment in the event of sun glare through the opening to reduce the sun glare, and such that when the desired illumination profile within a predefined tolerance is

20 achieved, the control system stops varying the dimming levels of the lamps and the adjustment of the window treatment.

58. The system of claim 57, wherein the dimming level of each lamp is selected by the control system from one of a plurality of lighting presets, each preset comprising a combination of dimming levels of the lamps and the control system selects a preset that will result in an appropriate supplementing of the daylight illumination to achieve the desired illumination profile in the space.

59. The system of claim 57, further comprising at least one second sensor for sensing daylight illumination entering the space and providing an input to the control system to control the at least one window treatment.

60. The system of claim 59, wherein the at least one second sensor provides an input to the control system to control the at least one window treatment to reduce sun glare.

61. The system of claim 57, wherein the at least one first sensor provides an input to the control system to control the at least one window treatment and the plurality of electric lamps.

62. The system of claim 57, further comprising a plurality of first sensors for sensing the illumination level in the space.

63. The system of claim 62, wherein a combine output level of the first sensor is determined by averaging outputs of the plurality of first sensors.

64. The system of claim 57, wherein the control system adjusts the window treatment to maximize the amount of daylight entering the space when the illumination level detected by said first sensor is too low.

65. The system of claim 57, wherein the control system adjusts the window treatment to minimize the amount of daylight entering the space when the illumination level detected by said first sensor is too high.

66. The system of claim 57, wherein the control system compares the illumination level in the space to first and second thresholds, the first threshold corresponding to a light level that is too dark and the second threshold corresponding to a light level that is too high.

67. The system of claim 57, wherein the control system adjust the sensitivity of the first sensor to compensate for the first sensor's differing sensitivity to different light source.

68. The system of claim 66, further wherein the control system has a main control loop in which the illumination level is compared to the first and second thresholds and a first subloop to select an appropriate dimming level of the plurality of electric lamps when the light level is too dark and a second subloop to select an appropriate dimming level of the plurality of electric lamps when the light level is too high.

69. The system of claim 68, wherein the control system determines in the main control loop if the light level is acceptable.

70. The system of claim 68, wherein the dimming levels comprise a plurality of preset dimming levels.

71. The system of claim 62, wherein the control system employs a dead-band having upper and lower set points such that if the sensed illumination in the space is outside the dead-band, the window treatment is adjusted to bring the illumination level in the space within the dead-band.

72. The system of claim 71, wherein the control system employs a time delay before moving the window treatment to bring the illumination level in the space back within the dead-band.

73. The system of claim 72, wherein the time delay to bring the illumination level in the space back within the dead-band is shorter for high illumination levels than for low illumination levels.

74. The system of claim 73, wherein the timing delay is reduced if daylight illumination is consistently high or consistently low.

75. The system of claim 71, wherein during a time period when glare from the sun through the opening can occur, at least one set point of the dead-band can be varied to reduce glare.

76. The system of claim 75, wherein a set point is variable during a time period determined by an estimated angle of the sun.

77. The system of claim 76, wherein the set point is reduced during the time period when glare from the sun through the opening can occur.

78. The system of claim 76, wherein the set point is variable during periods approximately two hours after sunrise and two hours before sunset.

79. The system of claim 76, wherein the control system includes an astronomical time clock and the set point is calculated in response to the time determined by the time clock.

80. The system of claim 57, wherein the sensor has a gain factor, and the control system adjusts the gain factor during the time period when glare from the sun through the opening can occur.

81. The system of claim 71, wherein a user can manually adjust the window treatment, and further wherein at least one of the set points is temporarily adjusted after a manual adjustment to match the light level measured after the manual adjustment.

82. The system of claim 81, wherein the control system reverts to a default set point after the light level exceeds a predefined dead-band around the temporary set point set after a manual adjustment.

83. The system of claim 82, wherein the default set point is adjusted automatically after the control system detects a repeated manual adjustment of the window treatment.

84. The system of claim 57, wherein the control system includes an astronomical time clock, and wherein the time of day data provided by the time clock is used to correct a spectral sensitivity property of the sensor.

85. A method for maintaining a desired illumination profile in a space throughout at least a portion of a day where the illumination sources include daylight and artificial light, the method comprising:

sensing an illumination level in at least a portion of the space;

5 supplementing the daylight illumination of the space with a plurality of electric lamps providing artificial light, the electric lamps being dimmable and being arranged in one or more zones in the space, the zones defining predefined volumes of the space, each zone having at least one lamp;

10 controlling with a control system responsive to the sensed illumination level the dimming levels of the plurality of electric lamps to maintain the desired illumination profile in the space, the step of controlling comprising adjusting the dimming level of the at least one lamp of each zone to achieve a desired illumination level in the respective zone and thereby maintain the desired illumination profile in the space and compensate for the daylight illumination in the space;

15 wherein the dimming level of each lamp is selected by the control system from one of a plurality of lighting presets, each preset comprising a combination of dimming levels of the lamps and wherein the control system fades the electric lamps toward a preset that will result in an appropriate supplementing of the daylight illumination to achieve the desired illumination profile in the space;

20 stopping varying of the dimming levels of the lamps when the desired illumination profile within a predefined tolerance is achieved; and

repeating the above steps during the day to maintain the desired illumination

profile throughout at least the portion of the day.

86. A method for maintaining a desired illumination profile in a space throughout at least a portion of a day where the illumination source comprises daylight entering the space, the method comprising:

sensing an illumination level in at least a portion of the space;

5 providing at least one electrically controllable window treatment for at least one opening for allowing daylight into the space, the window treatment selectively altering the amount of daylight entering the space through the opening;

controlling the at least one window treatment with a control system responsive to the sensed illumination level to achieve the desired illumination profile 10 in the space;

stopping adjusting the at least one window treatment with the control system when the desired illumination profile within a predefined tolerance has been achieved; and

repeating the above steps during the day to maintain the desired illumination 15 profile throughout at least the portion of the day.

87. A method for reducing sun glare through an opening into a space, the method comprising:

providing at least one electrically controllable window treatment for at least one opening for allowing daylight into the space, the window treatment selectively 5 altering the amount of daylight entering the space through the opening;

sensing daylight illumination entering the space;

controlling with a control system responsive to the sensed daylight 15 illumination the at least one window treatment; and

10       adjusting with the control system the window treatment in the event of sun  
glare through the opening to reduce the sun glare, and when the sun glare has been  
minimized, stopping adjustment of the at least one window treatment.

88.       The method of claim 87, wherein the step of adjusting the window  
treatment in the event of sun glare comprises comparing the sensed illumination level  
to first and second set points of a dead-band and if the sensed illumination level is  
outside the dead-band, adjusting the window treatment to bring the the space within  
5       the dead-band.

89.       The method of claim 88, further comprising varying at least one of the  
set points of the dead-band during a time period when sun glare is likely to occur.

90.       The method of claim 89, wherein the at least one set point is reduced  
in level during the time period when sun glare is likely to occur.

91.       The method of claim 88, further comprising adjusting a gain factor of  
the sensed illumination level.

92.       The method of claim 91, when the gain factor is increased during the  
time period when sun glare is likely to occur.

93.       A method for maintaining a desired illumination profile in a space  
throughout at least a portion of a day where the illumination source comprises  
daylight entering the space, the method comprising:

      providing at least one electrically controllable window treatment for at least

5        one opening for allowing daylight into the space, the window treatment selectively  
altering the amount of daylight entering the space through the opening;  
              sensing daylight illumination entering the space;  
              controlling with a control system responsive to the sensed daylight  
              illumination the at least one window treatment to maintain the desired illumination  
10        profile in the space throughout at least the portion of the day; and  
              further adjusting with the control system the window treatment in the event of  
              sun glare through the opening to reduce the sun glare, and when the desired  
              illumination profile within a predefined tolerance is achieved, stopping adjustment of  
              the at least one window treatment, further comprising repeating the above steps  
15        during the day to maintain the desired illumination profile throughout at least the  
              portion of the day.

94.        A method for maintaining a desired illumination profile in a space  
throughout at least a portion of a day where the illumination sources include daylight  
and artificial light, the method comprising:

5        sensing an illumination level in at least a portion of the space;  
              providing at least one electrically controllable window treatment for at least  
              one opening for allowing daylight into the space, the window treatment selectively  
              altering the amount of daylight entering the space through the opening;  
              supplementing the daylight illumination of the space with a plurality of  
              electric lamps providing artificial light, the electric lamps being dimmable;  
10        controlling with a control system responsive to the sensed illumination level  
              the at least one window treatment and the plurality of electric lamps to maintain the  
              desired illumination profile in the space;  
              controlling with the control system the plurality of electric lamps so that the

15 dimming level of each lamp is adjusted to achieve the desired illumination profile and compensate for the daylight illumination in the space throughout at least the portion of the day;

                  further adjusting with the control system the at least one window treatment in the event of sun glare through the opening to reduce the sun glare;

20 stopping varying of the dimming levels of the lamps and the adjustment of the window treatment when the desired illumination profile within a predefined tolerance is achieved; and

                  repeating the above steps during the day to maintain the desired illumination profile throughout at least the portion of the day.

95. An illumination maintenance system for maintaining a desired illumination profile in a space throughout at least a portion of a day where the illumination sources include daylight and artificial light, the system comprising:

5            at least one interior sensor for sensing an illumination level in at least a portion of the space;

                  at least one electrically controllable window treatment for at least one opening for allowing daylight into the space, the window treatment selectively altering the amount of daylight entering the space through the opening;

10            a plurality of electric lamps providing artificial light to supplement the daylight illumination of the space, the electric lamps being dimmable;

                  a control system controlling the at least one window treatment and the plurality of electric lamps to maintain the desired illumination profile in the space;

                  the control system controlling the plurality of electric lamps so that the dimming level of each lamp is adjusted to achieve the desired illumination profile and compensate for the daylight illumination in the space throughout at least a

portion of the day;

wherein the control of the electric lamps is implemented based on an open loop control algorithm and the control of window shading devices is implemented based on a closed loop control algorithm; and

20 wherein the control of both the electric lamps and the window treatments is based on a signal representing a single input variable derived from the at least one interior sensor.

96. The control system of claim 95 wherein the at least one interior light sensor is replaced by a plurality of interior light sensors whose output signals are processed by the control algorithms as a single input variable.